REMARKS

I. Status Of Prosecution

Claims 1-17 and 19 were pending. Claim 1, 8, 9, and 17 have been amended for purposes of clarity. Claims 20 and 21 have been added. Therefore, claims 1-17 and 19-21 will be pending upon the filing of this response.

Claims 1, 2, 4, 6, and 7 have been rejected under 35 U.S.C. §103(a) as being obvious over U.S. Patent No. 5,772,451 ("Dozier II") in view of U.S. Patent No. 6,203,690 ("Findeis") and U.S. Patent No. 4,767,344 ("Noschese"). Claims 8-11, 16, and 17 have been rejected under 35 U.S.C. §103(a) as being obvious over Dozier II in view of Noschese. Claims 3, 5, 13, and 15 have been rejected under 35 U.S.C. §103(a) as being obvious over the Dozier II in view of U.S. Patent No. 5,086,966 ("Melton"). Claims 12 and 14 have been rejected under 35 U.S.C. §103(a) as being obvious over Dozier II in view of Findeis. Claim 19 has been rejected under 35 U.S.C. §103(a) as being obvious over Dozier II in view of U.S. Patent No. 6,434,016 ("Zeng").

II. Summary Of Invention

Various methods of mounting electrical connectors to integrated circuit devices are known in the art (Specification at 1). One such method is surface mounting technology. Examples of surface mounting includes pin grid arrays (PGA's), ball grid arrays (BGA's), column grid arrays (CGA's), and land grid arrays (LGA's) (*id.*). For BGA's, the mechanical and electrical connection has been formed between a connector's solder bumps and landing pads disposed on a printed circuit board (*id.* 1-2). The connector is disposed on the printed circuit board so that the solder bumps align with the landing pads (*id.*). Locator pins

extending from the electrical component may be used to facilitate the initial alignment of the electrical connector with the printed circuit board by disposing the locator pins in holes in the printed circuit board (*id.* at 2). Following alignment, the assembly is heated to cause the solder bumps to flow and fuse with the landing pads, thereby forming an electrical and mechanical connection (*id.*). Also, a solder paste can be applied to the locator pins to help mechanically connect the connector to the printed circuit board (*id.*). By using alignment pins to mechanically connect the connector to the printed circuit board, a low-stress solder joint is formed between the solder balls and the landing pads (*id.*).

Although this methodology has been employed, it has some disadvantages. One such disadvantage is that during subsequent heat processing of the assembly, the solder that connects the locator pins to the printed circuit board may reflow causing the mechanical connection between the connector and the printed circuit board to be compromised (*id.*). The present invention overcomes this problem by creating a mechanical joint that is not compromised during subsequent thermal processing (*id.* at 2-3).

In an embodiment, the invention has an electrical component 10 that has an array of solder balls 21 and retentive pins 25, as shown in Figure 1 of the patent application which has been reproduced below (*id.* at 5). The retentive pins 25 have a base material that is plated with a material such as gold, palladium, platinum, silver, iridium, osmium, ruthenium, and rhenium (*id.* at 7).

Figure 1: Electrical Component with Plated Retentive Pins

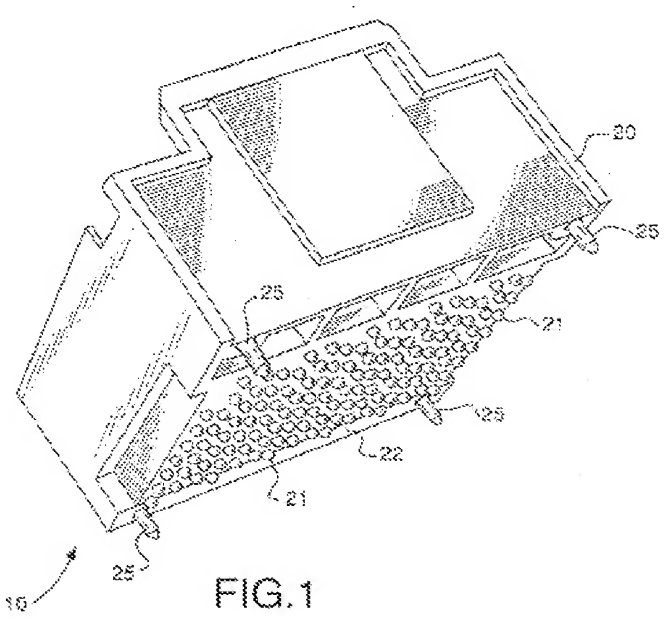


FIG.1

Also, in an embodiment, the invention may include a printed circuit board 40 having an array of landing pads 41 and retentive holes 45, as exemplified in Figure 2 of the patent application, which has been reproduced below (*id.* at 6).

Figure 2: Printed Circuit Board

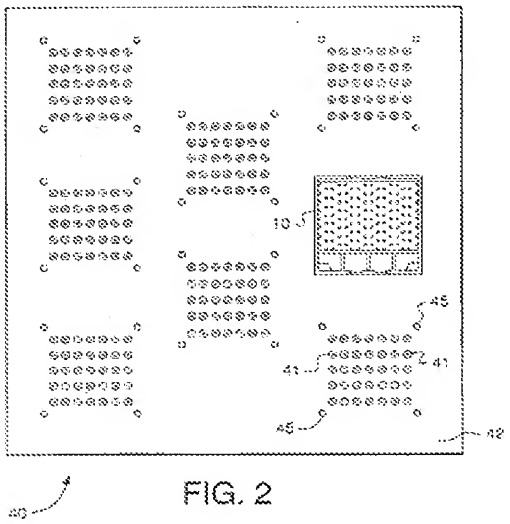
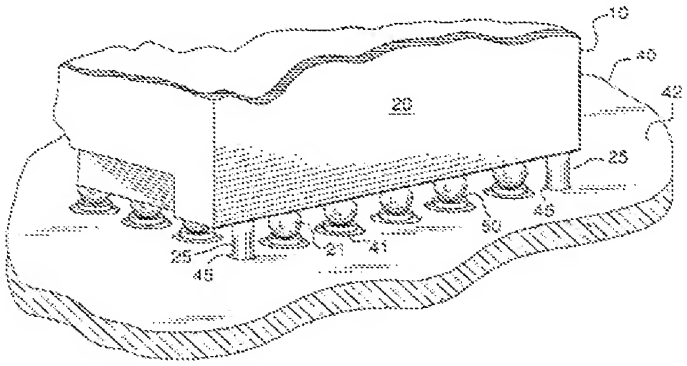


FIG. 2

During assembly, the electrical component's retentive pins 25 can be mated with the circuit board's holes 45 (*id.*). Preferably, the pins 25 have a smaller diameter than the holes 45 (*id.*). This permits self-alignment of the solder balls 21 with the landing pads 41 (*id.*). The connector 10 can be aligned with the printed circuit board and mated as shown in Figure 4 of the patent application, which has been reproduced below (*id.*).

Figure 4: Connector Aligned with Printed Circuit Board



During assembly, the electrical component 10 is mated to the printed circuit board 40, and heat is applied to the aligned component and printed circuit board (*id.*). The heat causes the solder balls 21 to flow and electrically connect the solder balls 21 to the landing pads 41 (*id.*). Also, solder disposed in the holes 45 melts (*id.*). Likewise, at least some of the pin plating material melts and mixes with the solder disposed in the holes 45 (*id.* at 7). The solder/plating material mixture affixes the pins 25 to the circuit board, thereby proving a secure mechanical connection between the component and the circuit board (*id.*). Also, a low-stress solder joint is formed between the solder balls 21 and the landing pads 41 because the mechanical connection is not dependent solely upon the solder masses (*id.* at 6). Figure 5 from the patent application, which has been reproduced below, shows an example of the mechanical connection between the retentive structure 25 and the circuit board 40.

Figure 5: Mechanical Connection Between Pin and Board

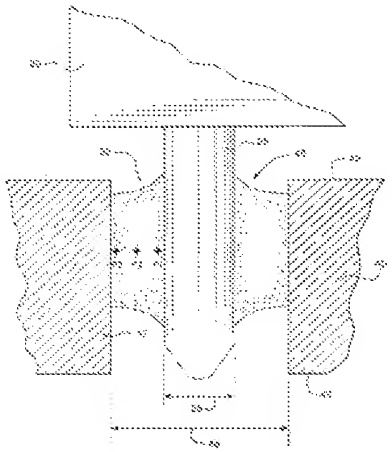


FIG. 5

The solder/plating material mixture has a higher reflow temperature than that of the solder alone (*id.* at 7). For example, in an embodiment, the solder/plating material melting temperature is at least 10°C higher than that of the solder alone (*id.*). Accordingly, during subsequent heat processing where solder is melted, the solder/plating material does not reflow (*id.*). This is advantageous because during subsequent heat processing, the mechanical connection between the component and the printed circuit board is maintained (*id.*). Further, by maintaining the integrity of this mechanical connection during subsequent processing, low-stress electrical connections are created between the solder balls and the landing pads (*id.*). Thus, the invention overcomes the deficiencies in the prior art.

There are four independent claims, claims 1, 8, 9, and 17, that reflect this inventive concept. By way of example, claim 1 recites an "electronic assembly, comprising a printed circuit substrate including a retentive through hole, a plurality of lands, and an electrical connector." Claim 1 further states that the electrical connector comprises (i) "a *housing*;" (ii) "*a plurality*

of solder masses extending from a surface of the housing for electrically connecting the electrical connector to the lands of the circuit substrate; and (iii) "*a retentive structure* extending from the surface of the housing, spaced apart from the plurality of solder masses, and positioned within the through hole, the retentive structure comprising a base material and *a plating material* disposed over at least a portion of the base material, the retentive structure having a cross-sectional area smaller than an area of the through hole so that a clearance exists between the retentive structure and a periphery of the through hole." Claim 1 further recites that "at least some of the plating material is for separating from the base material at a reflow temperature of the plurality of solder masses and combining with a solder composition within the through hole so that the solder composition and the plating material, upon cooling, form a bond between the printed circuit substrate and the retentive structure and the combination of the base material and the solder composition has a melting temperature that is higher than the melting temperature of the plurality of solder masses."

All of the pending claims having similar limitations. For example, independent claims 8, 9, and 17 recite:

Claim 8: the retentive pin "material that is for combining with a solder composition within the through hole to affix the electrical connector to a the circuit substrate at temperatures sufficient to initiate reflow of the plurality of solder masses"

Claim 9: "the retentive structure made with a material that alters a physical property of a solder composition in contact with the retentive structure within the through hole"

Claim 17: "a retentive structure extending from the surface of the housing, spaced apart from the plurality of solder masses, and being for positioning within a circuit substrate through hole, the retentive structure comprising a material that is for combining with a solder

composition within the through hole such that the melting temperature of the combination of the material and the solder composition is greater than the melting temperature of the solder masses."

As all of the claims have similar limitations, they are patentable for the same reasons as described below.

III. Response to Rejections

A. Independent Claim 1 is Nonobvious Over Dozier II, in view of Noschese and Findeis et al.

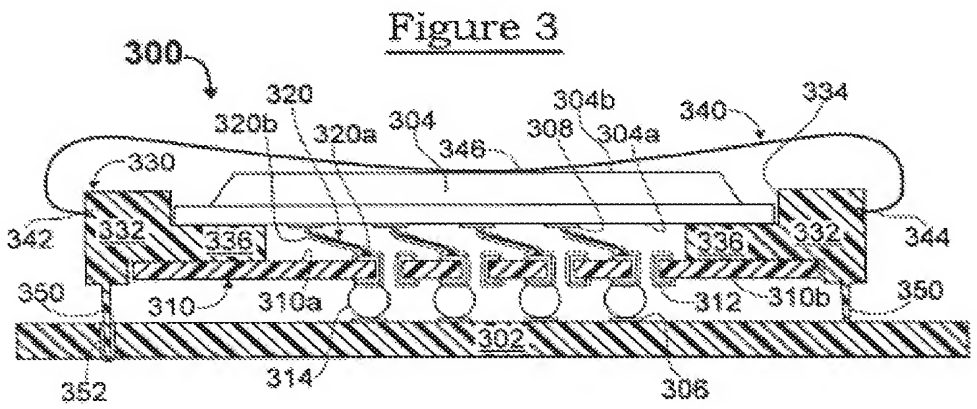
Independent claim 1 has been rejected as obvious over Dozier II in view of Noschese and Findeis et al. But applicants respectfully submit that independent claim 1 is patentable over these references because the references do not teach the claimed connector having a retentive structure with a "plating material" that separates "from the base material at a reflow temperature of the plurality of solder masses" and combines "with a solder composition within the through hole so that the solder composition and the plating material, upon cooling, form a bond between the printed circuit substrate and the retentive structure." As the Office Action admits, Dozier II fails to disclose the claimed plated retentive structure (Office Action at 3). Further, viewing Dozier II in light of Noschese and Findeis et al. does not render the claimed invention obvious because the references alone and in combination fail to teach some of the inventive features recited in claim 1. The deficiencies of Dozier II, and the deficiencies of Noschese and Findeis et al. are set forth below.

1. Dozier II's Teachings Are Deficient

Dozier II suffers from the drawbacks of the prior art. According to the Office Action, Dozier II discloses a printed circuit board substrate 302 having a retentive through hole, a

plurality of lands 306, and an electrical connector 10 having a plurality of solder masses 16 and a retentive structure 18 (Office Action at 3). The alleged retentive structure 18 extends through the holes (*id.* at 3).

Dozier II Figure 1: No Plating Material



But as the Office Action recognizes, Dozier II does not disclose a retentive structure having a base material and a plating material disposed over at least a portion of the base material, as recited in claim 1 (*id.*). Also, as the Office Action further acknowledges, Dozier II does not disclose that the "plating material separates from the base material," which is specified in claim 1 (*id.*).

Thus, as the Office Action recognizes, Dozier II differs significantly from the claimed invention and suffers from the drawback of the prior art because it does not disclose a retentive structure having a plating material. Further, Dozier II does not teach forming a mechanical joint between the retentive structure and a board that comprises solder and the plating material. Accordingly, Dozier II does not teach a joint that will resists reflow during further processing.

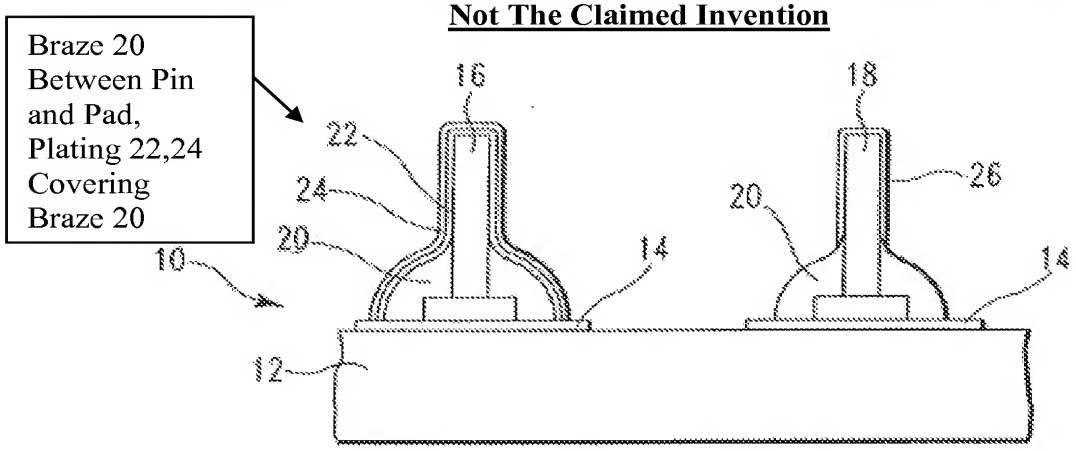
2. Findeis *et al.* Does Not Cure Dozier II's Deficiencies

The claimed invention is nonobvious because even if it were proper to combine Dozier II and Findeis et al., they do not teach, *inter alia*, a retentive structure having a plating material that separates from a base material to combine with solder composition.

According to the Office Action, Findeis *et al.* discloses a chip carrier "having at least one retentive element (16) being mounted thereon" (Office Action at 4) and it "would have been obvious to one of ordinary skill in the art at the time the invention was made to use the retentive element design of Findeis *et al.* for the retentive structure of Dozier II, for the purpose of providing thermal conductivity between the socket/housing and the circuit board" (*id.*). But the Office Action is wrong because it would not have been obvious to one of ordinary skill in the art to combine Dozier II and Findeis *et al.* to form the claimed invention.

Findeis *et al.* teaches a PGA chip carrier having a substrate 12 having input/output pins 16, 18 brazed to input/output pads by braze 20 (Findeis *et al.* at 2:46-50), as shown in Figure 1 reproduced below. Findeis *et al.* further teaches that the pins 16 ,18 and braze 20 are electroplated with nickel 22 and gold 24 (*id.* at 59-63).

Findeis et al. Figure 1: Teaches Plating a Pin Brazed to a Pad, Not The Claimed Invention



According to the Office Action, Findeis *et al.*'s electrical input/output pins 16 are the claimed "retentive structure" (Office Action at 4).

But Findeis *et al.* differs significantly from the claimed invention. Findeis *et al.* does not teach the claimed "solder masses" for providing electrical connections. Also, Findeis et al. does not disclose the claimed "retentive structure . . . spaced apart from the plurality of solder masses" (Claim 1). Further, Findeis et al. is silent with respect to how the input/output pins are connected or whether they extend into "a retentive through hole" as claimed (*id.*). Finally, Findeis *et al.* does not teach how the plated pins are connected to another structure, much less combined such that the plating material is combined with solder (*id.*).

Given the significant differences between the claimed invention and Dozier II and Findeis *et al.* one of ordinary skill in the art would not have been motivated to form the claimed invention for several reasons. First, as described above, it is undisputed that Dozier II does not disclose using plating with retentive elements to form a mechanical connection. Likewise, Findeis *et al.* does not disclose using solder to form a connection between a

retentive structure and a circuit board. In fact, the Office Action does not even allege that Findeis et al. discloses such a connection. To be sure, Findeis et al. discloses solder or braze 20, but that solder or *braze connects the input/output pins 16, 18 to the electrical pads 14* on the substrate, not another component, such as the claimed printed circuit board. As shown in the Figures below, Findeis *et al.*'s solder or braze 20 has a completely different purpose than the claimed solder.

Claimed Solder: Connecting Retentive Structure to PCB

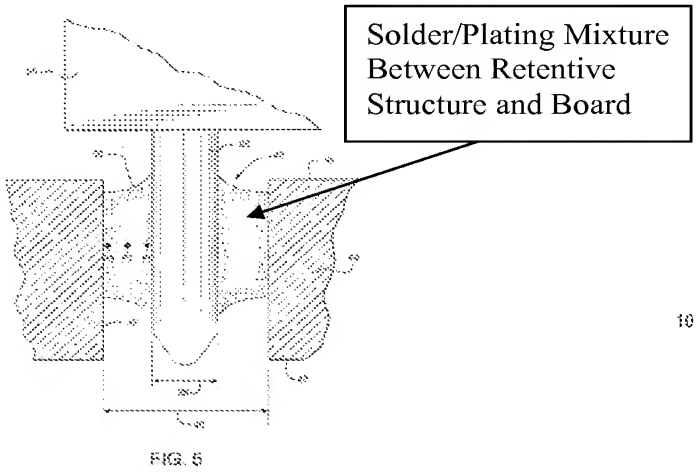


FIG. 5

Findeis et al.'s Braze Connecting Pins to Pads

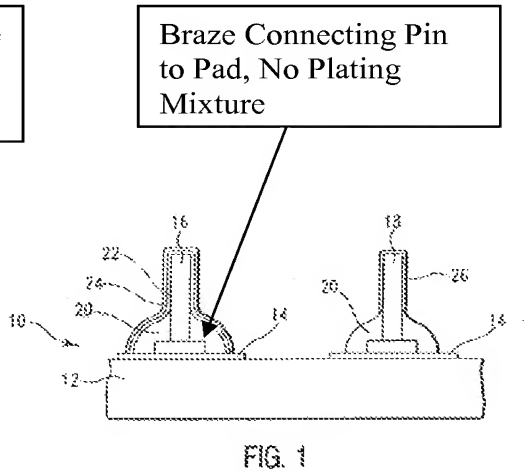


FIG. 1

Thus, as neither Findeis et al. nor Dozier II teach using solder to connect a retentive structure to a printed circuit board, the claimed invention is nonobvious in light of these patents.

Secondly, the claimed invention is nonobvious because neither Dozier II nor Findeis *et al.* teach a retentive structure having a *plating material that separates* from a base material to combine with solder composition. The Office Action admits that Dozier II has no such disclosure (Office Action at 3). Notably, the Office Action does not disclose that Findeis *et al.* has such a disclosure. Nor could it. The Office Action merely states that Findeis *et al.*'s input/output pins have nickel and gold plating 22, 24. But having plating is not the same as stating that the plating should separate from the base material as claimed. Nowhere does

Findeis *et al.* disclose that the nickel and gold 22, 24 plating should be separated to combine with solder. Rather, Findeis et al. teaches placing the plating 22, 24 *over the solder*, not melting solder and plating and combining it as claimed. In fact, such a disclosure appears to be contrary to the purpose of the Findeis *et al.*'s solder 20. Findeis *et al.*'s solder 20 connects the pins 16, 18 to the pads 14, and to melt it would destroy the connection and displace the pins. Thus, Findeis et al. in no way discloses, suggests, or leads to one of ordinary skill in the art to form the claimed invention.

One of ordinary skill in the art would not have been motivated to form the claimed invention in light of Dozier II and Findeis et al. for a third independent reason, namely neither Dozier II nor Findeis et al. even recognize the problem to be solved (*i.e.,* forming a joint that does not melt during subsequent processing). Neither Dozier II nor Findeis *et al.* provides any disclosure with respect to recognizing that a solder mixture can be formed with a higher reflow temperature to form a joint that will not reflow during subsequent heat processing of other solder joints. In fact, Findeis *et al.* only discloses one type of solder connection and does not describe two types of solder joints as recognized by the claimed invention. Accordingly, one of ordinary skill in the art would not have recognized by reading Findeis et al. that using a plated retentive structure can form a solder joint with a different reflow temperate to be used for further processing.

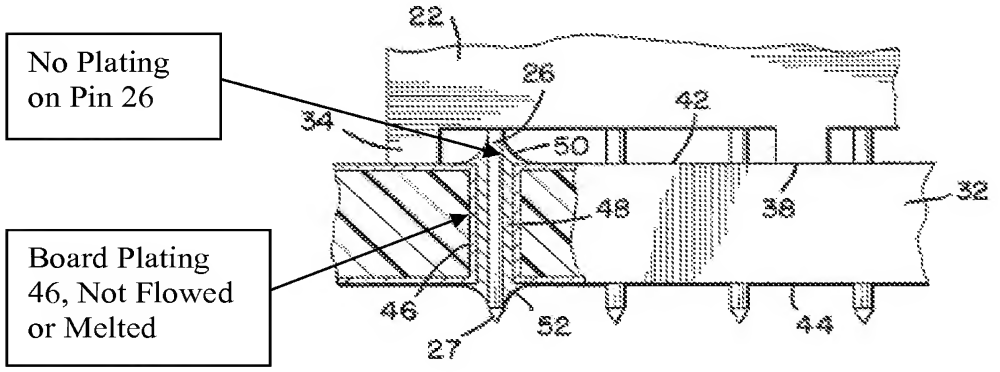
The claimed invention would not have been obvious to one of ordinary skill in the art in light of Dozier II and Findeis et al. for the additional reason that Findeis *et al.*'s alleged "retentive structures" are actually input/output pins who primary purpose is to provide electrical connections. More specifically, Findeis *et. al* discloses a PGA chip carrier having input/output pins that provide electrical connections. In contrast, Dozier II discloses solder

balls that provide electrical connections. Thus, if one of ordinary skill in the art was to combine Dozier II with Findeis, he would consider replacing Dozier II's solder balls with Findeis et al.'s pins, not Dozier II's retentive structures with Findeis et al.'s pins. The claimed invention retentive structure provides mechanical, not electrical connections. Thus, one of ordinary skill in the art would not consider substituting Findeis et al's electrical conductive pins for Dozier II's mechanically connective retentive structures.

3. Noschese Does Not Cure Dozier II's and Findeis et al.'s Deficiencies

Claim 1 is nonobvious in light of Dozier II, Findeis *et al.* and Noschese. Noschese does not cure the deficiencies of Dozier II and Findeis *et al.* According to the Office Action Noschese discloses a circuit substrate 32 having a through hole and a housing 22 having a retentive structure 26 and solder disposed between the retentive structure 26 and the substrate 32, as shown in Noschese Figure 4, reproduced below (Office Action at 4).

Noschese Figure 4: No Plating Over Alleged Retentive Structure



Noschese differs significantly from the claimed invention. Noschese does not disclose the claimed solder masses or any of the claimed limitations regarding the solder masses.

Further, Noschese does not disclose a retentive structure having plating. Nor does Noschese disclose a plating that can separate to combine with solder.

The claimed invention is nonobvious because like Dozier II and Findeis et al., Noschese does not teach a retentive structure having a plating material that separates from a base material to combine with solder composition. Notably, the Office Action does not even allege that Noschese has such a disclosure. Nor could it. Although Noschese discloses copper plating 46 disposed on the *substrate*, not on the *retentive element*, as claimed. Further, Noschese does not disclose that the plating should be separated to combine solder. In fact, Noschese shows just the opposite in Figure 4. Noschese depicts the plating 46 *unmelted and unflowed*. Absent a contrary disclosure, Noschese would not want to melt the plating 46 because Noschese's copper plating appears to be for electrical connection. Thus, Noschese combined Dozier II and Findeis *et al.* in no way discloses, suggests, or leads to one of ordinary skill in the art to form the claimed invention.

One of ordinary skill in the art would not have been motivated to form the claimed invention in light of Dozier II, Findeis *et al.,* and Noschese for a second independent reason, namely neither Dozier II nor Findeis *et al.* even recognize the problem to be solved (*i.e.*, forming a joint that does not reflow during subsequent processing). Neither Dozier II, Findeis *et al.*, nor Noschese provides any disclosure with respect to recognizing that a solder mixture can be formed with a higher reflow temperature to form a joint that will not flow during subsequent heat processing of other solder joints. In fact, Noschese only discloses one type of solder connection and does not describe two types of solder joints as recognized by the claimed invention. Accordingly, one of ordinary skill in the art would not have recognized by

reading Noschese that using a plated retentive structure can form a solder joint with a different reflow temperate to be used for further processing.

The claimed invention would not have been obvious to one of ordinary skill in the art in light of Dozier II, Findeis et al., and Noschese for the additional reason that Noschese's alleged "retentive structures" are actually electrical "contacts 26" who primary purpose is to provide electrical connections (Noschese 4:2-6). In contrast, Dozier II's discloses solder balls that provide electrical connections. Thus, if one of ordinary skill in the art was to combine Dozier II with Noschese, he would consider replacing Dozier II's solder balls with Noschese's pins, not Dozier II's retentive structures with Noschese's pins. Thus, one of ordinary skill in the art would not consider substituting Findeis et al's electrical conductive pins for Dozier II's mechanically connective retentive structures.

B. Independent Claims 8, 9, and 17 and the Dependent Claims Are Patentable For Substantially the Same Reasons As Independent Claim 1

Independent claims 8, 9, and 17 contain similar limitations to claim 1. Therefore, they are patentable over the cited references for the same reasons. As each of the independent claims are patentable, the dependent claims are patentable as well.

A notice of allowability is respectfully requested.

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